CLAIMS

What is claimed is:

> [Note: Bold bracketed ***and size-reduced*** **cross-referencing text** (e.g., **[100]**) is provided in the below claims as an aid for readability and for finding corresponding (but not limiting) examples of support in the specification. The so-bracketed text is not intended to add any limitation whatsoever to the claims and should be deleted in all legal interpretations of the claims and should also be deleted from the final published version of the claims.]

1. A method for forming vias [135] through an interlayer dielectric region [130] of a monolithically integrated device [100] where the interlayer dielectric region (ILD) is structured to separate a first conductive layer [119] from a second conductive layer [140] of the monolithically integrated device, the method comprising:

(a) providing [201] an Anti-Reflection Coating layer (ARC layer) [270] above the material of the ILD;

(b) providing a photoresist layer [280] above the ARC layer, where the photoresist layer includes a plurality of first openings [281] defined therethrough;

(c) creating [202] from the first openings, a plurality of second openings [271] extending through the ARC layer, where the second openings have inwardly-tapered sidewalls [272a] such that bottom width dimensions [275] of the second openings are smaller than corresponding width dimensions [285] of the first openings; and

(d) creating [203] from the second openings, a plurality of third openings [231] extending through the ILD material.

2. The method of Claim 1 wherein said first conductive layer [119] is part of an active layers set and wherein said second conductive layer [140] defines

a first major interconnect layer above said active layers set.

3. The method of Claim 1 wherein:

(a.1) said ARC layer is composed of an organic material;

(b.1) said photoresist layer is composed of an organic material; and

(c.1) said step of creating the second openings includes using an etch inhibitor [482b.1] which selectively adheres to organic surfaces.

4. The method of Claim 3 wherein:

(c.2) said step of creating the second openings includes creating a reactive ion plasma [407] having a carbohydrate-providing component [CHF3], having a fluorine-providing component [CF4], and having an inert bombardment component [Ar] .

5. The method of Claim 4 wherein:

(c.2a) the carbohydrate-providing component includes CHF3.

6. The method of Claim 4 wherein:

(c.2a) the fluorine-providing component includes CF4.

7. The method of Claim 4 wherein:

(c.2a) the inert bombardment component includes argon (Ar).

8. The method of Claim 4 wherein:

(c.2a) the carbohydrate-providing component includes CHF3;

(c.2b) the fluorine-providing component includes CF4; and

(c.2c) the ratio in the reactive ion plasma [407] of said CF4 to said CHF3, as measured by volumetric input flow is substantially less than five to one (5:1).

9. The method of Claim 8 wherein:

(c.2c1) said CF4 to CHF3 ratio is about or less than three to one (3:1).

10. The method of Claim 9 wherein:

(c.2c2) said CF4 to CHF3 ratio is about or less than one to one (1:1).

11. The method of Claim 1 wherein:

(d.1) said step of creating the third openings [231] includes causing isolated ones of said third openings to have bottom width dimensions, on average, of no more than about 0.20μm.

12. The method of Claim 1 wherein:

(d.1) said step of creating the third openings [231] includes causing densely-packed ones of said third openings to have bottom width dimensions, on average, of no more than about 0.18μm.

13. The method of Claim 1 wherein:

(c.1) said step of creating the second openings [271] includes causing the slopes of said inwardly-tapered sidewalls [272a] to be at least about four degrees or more away from a 90 degree vertical slope.

14. The method of Claim 13 wherein:

(c.1a) said step of creating the second openings [271] includes causing the slopes of said inwardly-tapered sidewalls [272a] to be inwardly sloped in a range of about 7 degrees to about 40 degrees away from a 90 degree vertical slope.

15. The method of Claim 14 wherein:

(c.1b) said step of creating the second openings [271] includes causing the slopes of said inwardly-tapered sidewalls [272a] to be inwardly sloped in a range of about 7 degrees to about 22 degrees away from a 90 degree vertical slope.

16. The method of Claim 1 wherein:

(d.1) said step of creating the third openings [231] includes causing said third openings to have sidewall profiles [431.5] that are not sloped by more than about 3 degrees away from a 90 degree vertical slope.

17. The method of Claim 1 wherein:

(d.1) said step of creating the third openings [231] includes creating a reactive ion plasma [408] having a carbon-providing component [CO], having a fluorine-providing component [C4F6], and having an inert bombardment component [Ar] .

18. The method of Claim 17 wherein:

(d.1a) the carbon-providing component includes carbon monoxide (CO).

19. The method of Claim 17 wherein:

(d.1a) the fluorine-providing component includes C4F6.

20. The method of Claim 17 wherein:

(d.1a) the inert bombardment component includes argon (Ar).

21. The method of Claim 1 wherein:

(d.1) said third openings [231] have bottom width dimensions [135a] , on average, that are at least 5 percent smaller than corresponding bottom width dimensions [285'] of corresponding first openings [281] in the photoresist layer.

22. The method of Claim 21 wherein:

(d.2) said third openings [231] have bottom width dimensions [135a] , on average, that are at least 10 percent smaller than the corresponding

bottom width dimensions [285'] of the corresponding first openings [281] in the photoresist layer.

23. The method of Claim 1 and further comprising:

(e) using a predefined photomask [290] to define width dimensions of the first openings [281]; and

(f) manufacturing plural monolithically integrated devices [100] each from said predefined photomask and each having a respective version of said ILD region [130] , of said photoresist layer [280] and of said ARC layer [270] with inwardly-tapered openings, but where at least two of the manufactured, monolithically integrated devices have differently dimensioned widths for their corresponding, third openings [231] extending through their corresponding ILD regions and have differently dimensioned widths for their corresponding, second openings [271].

24. The method of Claim 23 and further comprising:

(g) providing [205] respective conductive plugs [242] extending through said third openings of the respective monolithically integrated devices.

25. The method of Claim 24 and further comprising:

(h) providing [206] patterned conductive layers [240'] above the corresponding ILD regions of the respective monolithically integrated devices.

26. The method of Claim 25 wherein:

(h.1) at least two of said respective patterned conductive layers [240'] have different plug spacings [236a] and/or different spacings [245c'] between corresponding conductive lines [243a-243b] of their respective, patterned conductive layers.

27. A partially-fabricated, monolithically integrated device [100,202] comprising:

(a) a first conductive layer [119] ;

(b) an interlayer dielectric region (ILD) [130] provided above the first conductive layer;

(c) an Anti-Reflection Coating layer (ARC layer) [270] provided above the material of the ILD; and

(d) a photoresist layer [280] provided above the ARC layer, where the photoresist layer includes a plurality of first openings [281] defined therethrough;

(c.1) wherein a plurality of second openings [271] extend through the ARC layer from corresponding ones of the first openings and wherein the second openings have inwardly-tapered sidewalls [272a] such that bottom width dimensions [275] of the second openings are smaller than corresponding width dimensions [285] of the first openings.

28. The partially-fabricated, monolithically integrated device [100,202] of Claim 27 wherein:

(c.2) said ARC layer is composed of an organic material; and

(d.1) said photoresist layer is composed of an organic material.

29. The partially-fabricated, monolithically integrated device [100,202] of Claim 27 wherein:

(c.2) slopes of said inwardly-tapered sidewalls [272a] are at least about four degrees or more away from a 90 degree vertical slope.

30. The partially-fabricated, monolithically integrated device [100,202] of Claim 29 wherein:

(c.2a) the slopes of said inwardly-tapered sidewalls [272a] are inwardly

sloped in a range of about 7 degrees to about 22 degrees away from a 90 degree vertical slope.

31. The partially-fabricated, monolithically integrated device [100,202] of Claim 27 wherein:

(c.2a) said second openings [271] have bottom width dimensions [275] which are, on average, at least 5 percent smaller than corresponding bottom width dimensions [285'] of corresponding first openings [281] in the photoresist layer.

32. The partially-fabricated, monolithically integrated device [100,202] of Claim 27 and further characterized by:

(e) a plurality of third openings [231] extending through the ILD material, the third openings extending from said inwardly-tapered second openings.

33. A plurality of monolithically integrated devices [100,206] manufactured from a same, ILD-defining photomask [290] and each comprising:

(a) a first conductive layer [119] ;

(b) an interlayer dielectric region (ILD) [130] provided above the first conductive layer; and

(c) a second conductive layer [240'] provided above the ILD;

wherein:

(b.1) said ILD has vias [231] extending therethrough with conductive plugs [242] provided in the vias for coupling corresponding parts of the first and second conductive layers to one another; and

(b.2) at least two respective ones of said integrated devices that have been manufactured from said same, ILD-defining photomask [290] have respective ILD vias of different opening widths [235] and said different opening

widths are substantially smaller than hypothetical via opening widths [195c] specified by the ILD-defining photomask and photoresist openings [281] in a correspondingly patterned photoresist layer [280].

34. A contact forming method comprising:

(a) patterning [201] an organic photoresist layer [280] which is provided over an organic ARC layer [270], where the ARC layer is provided over a dielectric layer [230], the patterning of the photoresist layer causing through-holes [281] to be defined in the photoresist layer;

(b) using [202] an inwardly-tapering etch process [407] to continue the through-holes of the lithography mask into the ARC layer as inwardly-tapered through-holes [271] of the ARC layer;

(c) using [203] an anisotropic etch process [408] to continue the inwardly-tapered through-holes of the ARC layer into the dielectric layer as substantially vertical contact holes [231] through the dielectric layer; and

(d) filling [205] the substantially vertical contact holes with an electrical conductor [242].

35. The contact forming method of claim 34 wherein:

(b.1) said inwardly-tapering etch process [407] causes etch inhibitors [482b.1] to adhere to sidewalls of the photoresist layer through-holes.

36. The contact forming method of claim 34 wherein:

(c.1) said anisotropic etch process [408] causes etch inhibitors [482a.3] to adhere to sidewalls [472a.3] of the inwardly-tapered through-holes of the ARC layer.

37. The contact forming method of claim 34 wherein:

(d.1) said electrical conductor [242] includes a refractory metal.

***